

REMARKS

Applicants will address each of the Examiner's rejections in the order they appear in the Office Action.

Claim Rejections - 35 USC §112, First Paragraph

In the Office Action, the Examiner rejects Claims 43 and 48 under 35 USC §112, first paragraph.

In order to advance the prosecution of this application, Applicants are canceling Claims 43 and 48. Accordingly, it is respectfully requested that this rejection be withdrawn.

Claim Rejections - 35 USC §103

The Examiner also has the following rejections under 35 USC §103:

- (a) Claims 1, 2, 4, 5, 10, 11, 30, 31, 33, 34, 39-42, 44-47, 49 and 50 as being unpatentable over Zhang et al. '733 together with Saraswat et al.;
- (b) Claims 1, 2, 7, 8, 30, 31, 36, 37, 49 and 50 as being unpatentable over Zhang et al. '277 together with Saraswat et al.;
- (c) Claim 38 as being unpatentable over Zhang et al. '277 together with Saraswat et al. and Yamazaki et al. '271;
- (d) Claims 1, 2, 4, 5, 10, 11, 13, 14, 30-35, 39-42, 44-47 and 49 as being unpatentable over Yamazaki et al. '271 together with Saraswat et al.;
- (e) Claim 50 as being unpatentable over Yamazaki et al. '271 together with Saraswat et al. and Zhang et al. '277.

Each of these rejections is respectfully traversed.

In particular, even if the combination of these references is proper, which Applicants do not admit, the combination of them still fails to achieve the structure of the claimed semiconductor device of the present application.

More specifically, Zhang '733, Zhang '277 and Yamazaki disclose that both the semiconductor film for the driver circuit (i.e. the first active layer) and the semiconductor film for the pixel circuit (i.e. the second active layer) are formed from silicon film (see e.g. col. 5, lns. 55-57 in Zhang '733). Saraswat discloses that polycrystalline films of Ge/Si are deposited using LPCVD equipment which in the preferred process uses silane and germane as the sources of the Ge and Si (see e.g. col. 2, lns. 22-26 in Saraswat). Therefore, if these references are allegedly to be combined, then that means that Ge is added to silicon film which requires a further need. However, Saraswat only discloses that polycrystalline films of Ge/Si are deposited using LPCVD equipment. As a result, the combination of these references does not form a sufficient disclosure to achieve the structure of the claimed invention.

In contrast, as described in the present application for the claimed invention, an amorphous silicon film is formed by plasma CVD, and germanium is added to the amorphous silicon film using a technique such as ion implantation, plasma doping, or laser doping (see e.g. page 6, lns. 12-25 and Fig. 2A-2E of the present application). This allows the claimed structure to be formed. Hence, the alleged combination of reference is insufficient.

Furthermore, Applicants respectfully submit that Saraswat teaches away from using a polycrystalline film, such as recited in e.g. Claim 33 of the present application. For example, col. 4, lns. 55-64 of Saraswat discourages the use of such films by stating that polycrystalline silicon films must be annealed for many hours and at temperatures around 600° C to 625° C to achieve

meaningful dopant activation. Thus, Saraswat discloses using the $\text{Si}_{1-x}\text{Ge}_x$ films for an alleged significant improvement.

In contrast, the claims of the present application requiring the polycrystalline silicon film, such as for example Claim 33, refer to the first semiconductor film comprising crystalline silicon containing germanium and the second semiconductor film comprising crystalline silicon. Hence, these claims are clearly patentable over these references.

Applicants have also added the limitation of wherein the first active layer and the second active layer are formed on a same insulating surface over the substrate (or similar type language) to each of the independent claims. Applicants do not believe that this feature is shown or suggested by Zhang '277 (see e.g. Fig. 5K in Zhang '277). This is a further reason supporting the patentability of the claims over the cited references.

For at least the above-stated reasons, the claims of the present application are patentable over the cited references and in an allowable form. Accordingly, it is requested that they now be allowed.

New Claims

Applicants have also added new Claims 51-56. For similar reasons as discussed above, these claims are also allowable over cited references. Accordingly, it is requested that these claims be allowed. Please charge our deposit account 50/1039 for any fee for these claims.

Conclusion

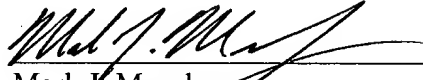
For the above stated reasons, the present application is now in a condition for allowance and should be allowed.

If any further fee is due for this amendment, please charge our deposit account 50/1039.

Favorable reconsideration is earnestly solicited.

Respectfully submitted,

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Marked-up copy of claims as amended:

IN THE CLAIMS:

Please amend the claims as follows:

1. (Third Amendment) A semiconductor device comprising:

a substrate;

a first thin film transistor having a first active layer comprising $\text{Si}_{1-X}\text{Ge}_X$ where $0 < X < 1$ formed over said substrate; and

a second thin film transistor having a second active layer comprising silicon formed over said substrate wherein said second active layer is not intentionally doped with germanium,

wherein the first active layer and the second active layer are formed on a same insulating surface over the substrate.

2. (Twice Amended) A semiconductor device comprising:

a substrate;

a first thin film transistor having a first active layer comprising $\text{Si}_{1-X}\text{Ge}_X$ where $0 < X < 1$ formed over said substrate; and

a second thin film transistor having a second active layer comprising silicon formed over said substrate, wherein said second active layer contains no germanium,

wherein the first active layer and the second active layer are formed on a same insulating surface over the substrate, and

wherein said first thin film transistor constitutes a CMOS circuit.

30. (Twice Amended) A semiconductor device having an active matrix type display device, said display device comprising:

a substrate having an insulating surface;

a plurality of pixel electrodes arranged in a matrix formed over said substrate;

a plurality of first thin film transistors for switching said pixel electrodes and formed over said substrate;

a driver circuit formed over said substrate for driving said plurality of first thin film transistors, said driver circuit comprising at least one second thin film transistor;

each of said first thin film transistors and said second thin film transistor comprising:

semiconductor film comprising silicon and including at least one channel region;

a gate insulating film adjacent to said channel region; and

a gate electrode adjacent to said gate insulating film,

wherein the semiconductor film of each of said first thin film transistors and said second thin film transistor are formed on the substrate having the insulating surface, and

wherein the semiconductor film of said second thin film transistor contains germanium at a higher concentration than the semiconductor film of said first thin film transistors and the semiconductor film of the first thin film transistors is not intentionally added with germanium.

33. (Third Amendment) A semiconductor device comprising:

a substrate having an insulating surface;

a first thin film transistor formed over said substrate, said first thin film transistor

comprising:

a first semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a first gate insulating film adjacent to said first semiconductor film; and

a first gate electrode adjacent to said first gate insulating film;

a second thin film transistor formed over said substrate, said second thin film transistor comprising:

a second semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a second gate insulating film adjacent to said second semiconductor film; and

a second gate electrode adjacent to said second gate insulating film,

wherein the first semiconductor film and the second semiconductor film are formed on the substrate having the insulating surface, and

wherein said first semiconductor film contains germanium at a higher concentration than said second semiconductor film and the second semiconductor film is not intentionally added with germanium.

36. (Twice Amended) A semiconductor device comprising:

a substrate having an insulating surface;

a first thin film transistor formed over said substrate, said first thin film transistor comprising:

a first semiconductor film comprising crystalline silicon formed over said substrate

and having a channel region;

a first gate insulating film adjacent to said first semiconductor film; and

a first gate electrode adjacent to said first gate insulating film;

a second thin film transistor formed over said substrate, said second thin film transistor comprising:

a second semiconductor film comprising amorphous silicon formed over said substrate and having a channel region;

a second gate insulating film adjacent to said second semiconductor film; and

a second gate electrode adjacent to said second gate insulating film,

wherein the first semiconductor film and the second semiconductor film are formed on the substrate having the insulating surface, and

wherein said first semiconductor film contains germanium at a higher concentration than said second semiconductor film and the second semiconductor film is not intentionally added with germanium.

Cancel Claims 43 and 48.

49. (Amended) A semiconductor device comprising:

a substrate;

a underlying layer formed over the substrate;

a first thin film transistor having a first active layer comprising $\text{Si}_{1-x}\text{Ge}_x$ where $0 < x < 1$ formed over said underlying layer; and

a second thin film transistor having a second active layer comprising silicon formed over said underlying layer wherein said second active layer is not intentionally doped with germanium,
wherein the first active layer and the second active layer are formed on a same insulating surface over the substrate.

Please add the following new claims:

51. (New) A semiconductor device comprising:

a substrate;

a first thin film transistor having a first active layer comprising $\text{Si}_{1-x}\text{Ge}_x$ where $0 < X < 1$ formed over said substrate; and

a second thin film transistor having a second active layer comprising silicon formed over said substrate wherein said second active layer is not intentionally doped with germanium,

wherein the first active layer and the second active layer are formed on a same insulating surface over the substrate,

wherein the first active layer and the second active layer include a metal capable of promoting crystallization of silicon, and

wherein said $\text{Si}_{1-x}\text{Ge}_x$ is polycrystalline silicon germanium and said silicon is polycrystalline silicon.

52. (New) A semiconductor device comprising:

a substrate having an insulating surface;

a first thin film transistor formed over said substrate, said first thin film transistor comprising:

a first semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a first gate insulating film adjacent to said first semiconductor film; and

a first gate electrode adjacent to said first gate insulating film;

a second thin film transistor formed over said substrate, said second thin film transistor comprising:

a second semiconductor film comprising crystalline silicon formed over said substrate and having a channel region;

a second gate insulating film adjacent to said second semiconductor film; and

a second gate electrode adjacent to said second gate insulating film,

wherein the first semiconductor film and the second semiconductor film are formed on the substrate having the insulating surface, and

wherein the first semiconductor film and the second semiconductor film include a metal capable of promoting crystallization of silicon,

wherein said $\text{Si}_{1-x}\text{Ge}_x$ is polycrystalline silicon germanium and said silicon is polycrystalline silicon, and

wherein said first semiconductor film contains germanium at a higher concentration than said second semiconductor film and the second semiconductor film is not intentionally added with germanium.

53. (New) A semiconductor device according to claim 51 wherein said semiconductor device is selected from the group consisting of a handy phone, a video camera, a mobile computer, a head-mount display, a rear-type projector and a front-type projector.

54. (New) A semiconductor device according to claim 52 wherein said semiconductor device is selected from the group consisting of a handy phone, a video camera, a mobile computer, a head-mount display, a rear-type projector and a front-type projector.

55. (New) The semiconductor device according to claim 51 wherein the metal is selected from the group consisting of nickel, iron, cobalt, and platinum.

56. (New) The semiconductor device according to claim 52 wherein the metal is selected from the group consisting of nickel, iron, cobalt, and platinum.